

Extrapleural Thoracoscopic Anterior Spinal Fusion: A Modified Video-Assisted Thoracoscopic Surgery Approach to the Pediatric Spine

Saleem Islam, MD, M. Timothy Hresko, MD, Steven J. Fishman, MD

ABSTRACT

Video assisted thoracoscopic surgery (VATS) has recently been developed as an alternative to thoracotomy for anterior spinal surgery. We report a case in which an extrapleural dissection was combined with VATS to further improve this approach.

Key Words: Thoracoscopy, Anterior spinal fusion, Extrapleural.

INTRODUCTION

The thoracoscopic approach to the chest was first described in 1922 by Jacobaeus for the division of tuberculous adhesions.¹ With the recent rapid advances in video technology, interest has been revived in thoracoscopy. As a result, video assisted thoracoscopic surgery (VATS) has been introduced. VATS has been used to perform a wide variety of thoracic procedures including wedge resection of lung nodules, lobectomies, biopsy or removal of mediastinal masses, esophageal myotomy, and empyema debridement.²⁻⁴ This approach has also been successfully adopted for anterior spinal surgery in adults and for children with congenital deformities.^{4,5}

Congenital scoliosis and kyphosis are progressive conditions that lead to a variety of complications including pulmonary, cardiac, and neurologic dysfunction, if left untreated.⁶ Combined anterior and posterior spinal fusion are currently recommended for treating progressive deformity in the growing child.^{6,7} The conventional operative strategy consists of thoracotomy for the anterior fusion followed by posterior spinal surgery at the same time or at a later stage in the progression of the condition. VATS allows surgeons to perform the anterior component with less morbidity. We describe here a modification to the VATS approach, which has the potential to further reduce short- and long-term morbidity.

CASE REPORT

A 3-year-old-girl with congenital scoliosis of the T 2, 3, and 4 area came to Children's Hospital in Boston with progressive worsening of the scoliosis (**Figure 1**). Anterior and posterior spinal fusion was recommended. The patient was brought to the operating room, and after the induction of general anesthesia, she was intubated with a single-lumen tube into the left bronchus. Single-lung ventilation was initiated. A 1.5-cm incision was made in the 4th intercostal space in the midaxillary line. The intercostal muscles were carefully divided without entering the pleural space. The parietal pleura was then gently dissected off the chest wall with cotton swabs and sponge tipped instruments. After the creation of an extrapleural space, two 5-mm thoracoscopy ports were introduced and further blunt pleural dissection was car-

Department of General Surgery (Drs. Islam and Fishman).
Department of Orthopedic Surgery (Dr. Hresko).

Boston Children's Hospital, Harvard Medical School, Boston, Massachusetts

Address reprint request to: Steven J. Fishman, MD, Department of Surgery,
Children's Hospital, 300 Longwood Avenue, Boston, MA 02115, USA. Telephone:
(617) 355-8166, Fax: (617) 738-0864, E-mail: steven.fishman@tch.harvard.edu

© 2001 by JSLS, *Journal of the Society of Laparoendoscopic Surgeons*. Published by
the Society of Laparoendoscopic Surgeons, Inc.



Figure 1. Preoperative radiograph of the thoracic spine demonstrating severe congenital scoliosis of T2-4.

ried out until the entire thoracic apex, suprahilar mediastinum, and upper thoracic spine were exposed. Excellent access to the anterior spine was obtained from T 1-5. The pleural envelope and contained lung were retracted inferiorly with a soft inflatable balloon retractor. Anterior discectomy and spinal fusion were performed in the standard manner using bone allografts. Radiographs confirmed the location of the surgical fusion. The VATS instruments were withdrawn, and the extrapleural cavity aspirated free of air with a rubber catheter after withdrawing the endotracheal tube back from the bronchus into the trachea, inflating the lung, and instituting double-lung ventilation. No chest tube was placed. The thoracoscopy port incisions were closed, and the patient was then turned prone for the posterior fusion, which was performed in the standard fashion.

The patient's postoperative course was unremarkable except for the development of transient ipsilateral Horner's syndrome, which resolved itself prior to discharge. She was discharged on postoperative day four.

DISCUSSION

Minimally invasive techniques in surgery have revolutionized surgical thinking and induced a paradigm shift in the previously accepted dogma of large and wide inci-

sions. Advantages of the minimally invasive approach include less postoperative pain, shorter length of stay in the hospital, earlier return to work, and less obtrusive scarring. These advantages have been extensively documented in the laparoscopic and thoracoscopic literature.^{4,8} Over the past few years, this approach has also been used for gaining access to the anterior spine for correction of deformities, removal of discs, and fusion.⁹

Studies in children with spinal deformities such as congenital scoliosis and kyphosis have shown that the thoracoscopic approach results in less postoperative pain and ipsilateral shoulder girdle dysfunction than is seen with open thoracotomy.¹⁰ This is because thoracotomy entails dividing multiple muscles and distracting the chest wall, sometimes fracturing ribs. VATS, on the other hand, allows small, muscle-sparing incisions with no distraction.¹⁰ In one analysis, VATS did not have an impact on the length of hospital stay because of the simultaneous posterior fusion that was performed.¹¹ As with all other endoscopic procedures, a significant learning curve is required, with operative times becoming comparable after the performance of a few procedures.¹² In terms of surgical exposure, video assisted thoracoscopic surgery provides a superior view of the entire anterior thoracic spine with single-lung ventilation, high-resolution cameras, and video equipment.¹³ With a standard thoracotomy approach, often a separate incision must be made to visualize and expose the highest and lowest thoracic vertebrae.¹³

In our case, we dissected an extrapleural plane for the VATS without transgressing the pleural space. To our knowledge, this is the first time the retropleural approach has been performed thoracoscopically. The extrapleural approach to the mediastinum is an uncommon one. However, extrapleural thoracotomy is used routinely in newborns to access and repair congenital esophageal atresia and tracheoesophageal fistula anomalies. An operative laparoscopic retroperitoneoscopy technique that employs similar methods of dissection to create access for videoscopic instruments has been described in the literature.¹⁴

We hypothesize that this technique will enhance the superiority of the VATS approach to the spine by preventing the postsurgical pleural scarring that inevitably occurs. This scarring causes the visceral and parietal pleurae to become adherent, making future thoracic access difficult, if not hazardous. In addition, the retro-

pleural approach obviates the need to incise the pleura over the spine to perform discectomy and fusion. In our experience with transpleural thoracoscopic spinal access, closure of the pleura over the bone chip allografts is difficult. Bone fragments can easily dislodge from the intervertebral spaces and fall into the pleural cavity. Pleural closure may be impossible when thoracic anterior spinal instrumentation is placed. With the retropleural technique, the intact pleura is compressed up against the spine when the lung is ventilated. Thus, allograft chips are more likely to remain in place, because the pleural space is never opened.

In our case, we also eliminated the need for tube thoracotomy, which is a significant cause of pain and distress postoperatively. Though pneumothorax is not likely after a purely retropleural approach, in some cases a retropleural chest tube might be desirable to diminish the risk of postoperative hematoma. The discretion of the surgeon based on the hemostasis in any particular case will facilitate this decision. Because our approach remained extrapleural, we believe that less potential exists for lung injury from the trocars and instruments. We felt that the exposure obtained by this method was comparable to that achieved by standard VATS, and the anterior spinal release and correction was also not different from that of VATS or thoracotomy. The retropleural approach is particularly suited to upper spinal access. Low thoracic spinal procedures would be more difficult due to the dense adherence of the pleura to the diaphragm.

References:

1. Jacobaeus HC. The practical importance of thoracoscopy of the chest. *Surg Gynecol Obstet.* 1922;34:289-296.
2. Kaiser L. Video assisted thoracic surgery: current state of the art. *Ann Surg.* 1993;6:720-734.
3. Rothenberg S. Thoracoscopy in infants and children. *Semin Pediatr Surg.* 1998;7:194-201.
4. McFadden PM, Robbin RJ. Thoracoscopic Surgery. *Surg Clin N Am.* 1998;78:763-772.
5. Holcomb GW 3rd, Mencio GA, Green NE. Video assisted thoracoscopic discectomy and fusion. *J Pediatr Surg.* 1997;32:1120-1122.
6. Rothenberg S, Erickson M, Eilert R, et al. Thoracoscopic anterior spinal procedures in children. *J Pediatr Surg.* 1998;33:1168-1170.
7. Burgos J, Rapariz JM, Herranz PG. Anterior endoscopic approach to the thoracolumbar spine. *Spine.* 1998;23:2427-2431.
8. The Southern Surgeons Club. A prospective analysis of 1518 laparoscopic cholecystectomies. (published erratum – *N Engl J Med.* 1991;325:1517-1518) *N Engl J Med.* 1991;324:1073-1078.
9. Cunningham BW, Kotani Y, Mc Nulty PS, et al. Video assisted thoracoscopic surgery versus open thoracotomy for anterior thoracic spinal fusion. *Spine.* 1998;23:1333-1340.
10. Landereau R, Hazelrigg S, Mack M, et al. Postoperative pain related morbidity: video assisted thoracic surgery versus thoracotomy. *Ann Thorac Surg.* 1993;56:1284-1289.
11. Newton PO, Wenger DR, Mubarak SJ, Meyer RS. Anterior release and fusion in pediatric spinal deformity. A comparison of early outcome and cost of thoracoscopic and open thoracotomy approaches. *Spine.* 1997;22:1398-1406.
12. McAfee PC, Regan JR, Zdeblick T, et al. The incidence of complications in endoscopic anterior thoracolumbar spinal reconstructive surgery. A prospective multicenter study comprising the first 100 consecutive cases. *Spine.* 1995;20:1624-1632.
13. Huang TJ, Hsu RWW, Liu HP, et al. Technique of video assisted thoracoscopic surgery for the spine: new approach. *World J Surg.* 1997;21:358-362.
14. Gaur DD. Laparoscopic operative retroperitoneoscopy. Use of a new device. *J Urol.* 1992;148:1137-1139.